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PERFORMANCE AND EVALUATION OF DIFFERENT MODIFIED 'T' INVERTED SWEEP TYPE FURROW OPENERS FOR TRACTOR DRAWN SEED DRILL UNDER VERTISOL

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ABSTRACT

The unsatisfactory performance has been found of zero till drill in the black cotton soil with inverted 'T' type furrow openers. Hence the research work was conducted to improve the performance of T-inverted furrow openers. The sweep type T-inverted furrow opener was selected for the research work. After designing the T-inverted furrow opener zero till drill's tines were replaced and performance and evaluation of the developed tine was acrid out in randomized block design field (0.38 ha) with three replications. The study was taken under two levels of forward speeds and two soil moisture contents. On the basis of results and statistical analysis, the tine N_0 was found best over the other tines on the basis of field efficiency, draft and fuel consumption. The tine N_0 required 6.65 and 16.38% less draft compared to N_1 and N_2 and the difference was significantly higher at 5% level. Similarly tine N_0 required N_0 required 13.98 and 22.25% less fuel consumption compared to N_1 and N_2 and the difference was also significantly higher at 5% level.

KEYWORDS: T' Type Furrow Opener, Fuel Consumption & Three Replications

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INTRODUCTION

Due to the paddy stubbles the bed preparation for wheat sowing is difficult after rice harvesting especially when rice is harvested by combine harvester. To get favorable condition agriculturist generally plough the field three to four times and leveled by a blade harrow for wheat sowing hence there will be substantial loss of soil moisture and it will take long time to wheat sowing from rice harvest. This causes delay in sowing which result in reduced crop yield of 30-40 kg per ha per day if crop is sown after 13th November (Beranwall, 1985). These losses can be overcome by early sowing of wheat by zero till drill. But one of the negative effects of zero till drill is greater infestation of weeds in wheat fields (Gill and Arshad, 1995) and fertilizers are applied on the soil surface rather than mixed into the sub-surface soil. As a result, most of the applied fertilizer is directly exposed to air and sunlight, which may result losses of fertilizer. That is why a research work was conducted to overcome the aforementioned losses of zero till drill by exploring the benefits of sweep type T-inverted furrow openers. By this sowing implement, sowing and application of fertilizer can be done without any preparation prior to sowing. The Sweep T-inverted furrow openers is the part of the modified tine till drill which removes weed and give open passage for the seed to place and cover in the soil.

METHODOLOGY

It has been found by (Shrivastava and Jha, 2011), under Vertisol performance of zero till drill with T-inverted furrow opener do not work satisfactory under for wheat cultivation after paddy. Hence T- Inverted furrow openers with different sizes of sweep i.e. N_0, N_1, N_2 was selected for the research work. After designing the furrow openers the sweep type T- inverted furrow openers were fabricated. The lift angle was kept same i.e. 12^0 for all sweep. The tine N_0 had nose angle 60^0, width 130 mm, N_1 had nose angle 80^0, width 150 mm and N_2 had nose angle 100^0, width 170 mm respectively. Material was selected for construction for all three sweep high carbon steel having carbon content of 0.5 % and thickness 5 mm. The Figure 3 to 4 shows the view of different tines and modified tine till drill respectively. Performance of different modified tine N_0, N_1 and N_2 was carried out on the basis of dependent variables such as fuel consumption, field efficiency and draft at two forward speeds and two soil moisture content. For design of sweep nose angle (sweep angle) which is the angle between two intersecting lines of wings is one of the important factors that need to be considered for easy undercutting of roots of weeds through sweep. The lift angle was another factor that needs to be considered during the operation of sweep and defined as the angle of inclination of wing in the direction of travel when sweep was placed on flat surface and working position. Numbers of tine were selected in such way that the stubble accumulation during the operation of implement could be reduced and for proper width of operation end of the wings were also cut parallel to each other so that proper width could be maintained.

Figure 1: View of Tine N_0

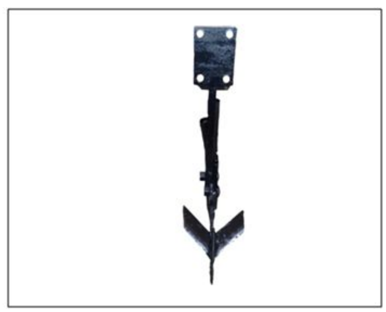

Figure 2: View of Tine N_1

Figure 3: View of Tine N_2

Figure 4: View of Modified Tine till Drill

RESULTS AND DISCUSSIONS

On the basis of dependent variables such as draft, fuel consumption and field efficiency the performance of different modified tines were carried out with two levels of moisture content and operating speed. Results of the research work were categorized as given below:

Effect of Speed and Moisture Content on Draft Requirement for Modified Tines

The results were obtained from the study were showed in Table 7. It was calculated from the Table 7 that at operating speed of 3.0 km/h and soil moisture content M_0 (16.42%, db) tine N_0 required 6.64 and 16.37% less draft compared to N_1 and N_2 respectively. Whereas at operating speed of 4.5 km/h and soil moisture content M_0 the tine N_0 required 11.28 and 15.82% less draft compared to N_1 and N_2 respectively. Similarly at the operating speed of 3.0 km/h and field moisture content M_1 (12.49, db) the tine N_0 required 9.57 and 22.96% less draft compared to N_1 and N_2 respectively. Whereas at the operating speed of 4.5 km/h and field moisture content M_0 the tine N_0 required 10.40 and 15.42% less draft compared to N_1 and N_2 respectively. It is evident from the Table 1 that the highest draft was found in the interaction N_2M_1 which was found highly significant over the other interaction and lowest draft was found in interaction N_0M_0.

Table 1: Effect of Modified Tine and Moisture Content on Draft Requirement

	M_0	M_1	Mean
N_0	3.137	3.370	3.253
N_1	3.458	3.745	3.602
N_2	3.733	4.137	3.935
Mean	3.443	3.751	

	N	M	N×M
SEm ± =	0.9373	0.0765	0.1325
CD (0.05) =	0.1934	0.1579	0.2735

Similarly the Table 2 was revealed that highest draft was required in intercalation S_1N_2 which was found highly significant over the other interaction and lowest draft was found in interaction S_0N_0. Therefore it was concluded that speed S_0 was better than S_1 and soil moisture content M_0 was found better than M_1. The tine N_0 was required less draft compared to N_1 and N_2 at both soil moisture content and operating speed. It may be due to less width and less nose angle of tine N_0 as compared to N_1 and N_2 and at higher speed the cutting units get more exposed in soil per unit time. Similar findings also reported by Mohammad and Khalifahamzehghasem (2013).

Table 2: Effect of Speed and Modified Tine on Draft Requirement

	N_0	N_1	N_2	Mean
S_0	2.968	3.232	3.707	3.302
S_1	3.538	3.972	4.163	3.891
Mean	3.253	3.602	3.935	

	S	N	S×N
SEm ± =	0.0765	0.9373	0.1325
CD (0.05) =	0.1579	0.1934	0.2735

Effect of Speed and Moisture Content on Fuel Consumption for Modified Tines

It was calculated from the Table 7 that at the soil moisture content M_0 (16.42%, db) and operating speed of 3.0 km/h the tine N_0 required 13.97 and 22.24% less fuel consumption compared to N_1 and N_2 respectively. Whereas at operating speed of 4.5 km/h the tine N_0 required 17.39 and 21.72% less fuel consumption compared to N_1 and N_2

respectively. Similarly at the soil moisture content M_1 (12.49%, db) and operating speed 3. 0 km/h the tine N_0 required 9.27 and 19.93% less fuel consumption compared to N_1 and N_2 respectively. Whereas at the operating speed of 4.0 km/h the tine N_0 required 15.92 and 23.58% less fuel consumption compared to N_1 and N_2 respectively. It was calculated from the Table 3 highest fuel consumption was found in the interaction N_2M_1 which was found highly significant over the other interaction and lowest fuel consumption was found in the interaction N_0M_0.

Table 3: Effect of Modified Tine and Moisture Content on Fuel Consumption

	M_0	M_1	Mean
N_0	6.766	7.583	7.175
N_1	8.033	8.950	8.492
N_2	8.683	9.983	9.333
Mean	7.827	8.839	

	N	M	N×M
SEm ± =	0.2452	0.2002	0.3468
CD (0.05) =	0.5061	0.4132	0.7157

Similarly it was calculated from the Table 4 highest fuel consumption was required in the interaction S_1N_2 which was found highly significant over the other interaction and lowest fuel consumption was found in the interaction S_0N_0. Therefore it was concluded that speed S_0 is better than S_1 and the soil moisture content M_0 is better than M_1. Tine N_0 was better than N_1 and N_2 at both soil moisture and operating speed. It may be due to at low soil moisture content and more speed of operation there may be more draft requirement of tine having high specification which is cause for the more fuel consumption.

Table 4: Effect of Speed and Modified Tine on Fuel Consumption

	N_0	N_1	N_2	Mean
S_0	7.033	7.950	8.916	7.966
S_1	7.316	9.033	9.750	8.700
Mean	7.175	8.492	9.333	

	S	N	S×N
SEm ± =	0.2002	0.2452	0.3468
CD (0.05) =	0.4132	0.5061	0.7157

Effect of Speed and Moisture Content on Actual Field Efficiency for Modified Tines

It was calculated from the Table 7 at moisture content M_0 (16.42%, db) and operating speed of 3.0 km/h the field efficiency of tine N_0 was found 8.17 and 11.08% more compared to N_1 and N_2 respectively. Whereas at operating speed of 4.5 km/h the field efficiency of tine N_0 was found 7.34 and 14.99% more compared to N_1 and N_2 respectively. Similarly at the moisture content M_1 (12.49%, db) and the operating speed 3.0 km/h the field efficiency of tine N_0 was found 6.04 and 15.75% more compared to N_1 and N_2 respectively. Whereas at the operating speed 4.5 km/h the field efficiency of tine N_0 was found 6.65 and 10.15% more compared to N_1 and N_2 respectively. Similar findings also reported by Shekhar *et al.* (2010). It was evident from the Table 5 the highest field efficiency was found in interaction N_0M_0 which was highly significant over the other interaction and lowest field efficiency was found in interaction N_1M_1.

Table 5: Effect of Modified Tine and Moisture Content on Field Efficiency

	M_0	M_1	Mean
N_0	71.016	68.028	69.522
N_1	65.900	63.981	64.941
N_2	62.881	60.185	61.533
Mean	66.599	64.065	

	N	M	N×M
SEm ± =	1.1074	0.9042	1.1566
CD (0.05) =	2.2855	1.8661	3.2323

Similarly the Table 6 was revealed that highest field efficiency was found in S_0N_0 which was highly significant over the other interaction and lowest field efficiency was found in interaction S_1N_2. Therefore it is concluded that speed S_0 was better than S_1 and soil moisture content M_0 was better than M_1. The tine N_0 was found better than N_1 and N_2 at both operating speed and soil moisture content. It may be due to low nose angle of tine N_1 over to other and at low speed there was minimum accumulation of stubble into the implement and tine N_0 required less draft and less time to perform the work over the other tines.

Table 6: Effect of Speed and Modified Tine on Field Efficiency

	N_0	N_1	N_2	Mean
S_0	72.615	67.798	64.068	68.160
S_1	66.430	62.083	58.998	62.504
Mean	69.523	64.941	61.533	

	S	N	S×N
SEm ± =	0.9042	1.1074	1.5661
CD (0.05) =	1.8661	2.2855	3.2323

CONCLUSIONS

At the both moisture content and operating speed the tine N_0 was required less draft and less fuel consumption as compared to N_1 and N_2 whereas at both moisture content and speed the field efficiency of tine N_0 was found more than to N_1 and N_2. Consequently tine N_0 was found superior over to other tine for tractor drawn seed drill for wheat cultivation after paddy under Vertisol.

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Table 7: Performance of Developed Sweep Type Furrow Openers at Different Speeds and Soil Moisture Contents

S.No.	Particular		Tine N_0		Tine N_1		Tine N_2	
			M_0 (16.42%,Db)	M_1 (12.49%,Db)	M_0 (16.42%,Db)	M_1 (12.49%,Db)	M_0 (16.42%,Db)	M_1 (12.49%,Db)
1.	Date of test		16/12/2015	25/12/2015	16/12/2015	25/12/2015	16/12/2015	25/12/2015
2.	Topography of soil		plain	plain	Plain	plain	Plain	plain
3.	Type of soil		Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam
4.	Plot size, ha		0.054	0.054	0.054	0.054	0.054	0.054
5.	Stubble height, cm		20	20	20	20	20	20
6.	Bulk density, gm/cc		1.51	1.45	1.51	1.45	1.51	1.45
7.	Cone index. kPa		297	285	297	285	297	285
8.	Draft, kN	at speed 3.0 km/h	2.81	3.12	3.01	3.45	3.36	4.05
		at speed 4.5 km/h	3.46	3.62	3.90	4.04	4.11	4.28
9.	Field capacity, ha/h	at speed 3.0 km/h	0.39	0.38	0.36	0.32	0.27	0.25
		at speed 4.5 km/h	0.54	0.51	0.46	0.41	0.36	0.32
10.	Field efficiency, %	at speed 3.0 km/h	73.47	71.76	67.92	67.68	66.14	62.00
		at speed 4.5 km/h	68.57	64.29	63.88	60.29	59.63	58.37
11.	Weeding efficiency , %	at speed 3.0 km/h	67.14	71.78	71.01	74.26	79.45	82.07
		at speed 4.5 km/h	75.48	77.54	77.01	79.34	83.08	84.63
12.	Fuel consumption, l/ha	at speed 3.0 km/h	6.6	7.5	7.6	8.3	8.5	9.4
		at speed 4.5 km/h	7.0	8.1	8.4	9.6	8.9	10.6